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ABSTRACT

One of a set of fourteen instructional outlines for use in a course to train novice firemen, this guide covers the topic of motorized fire apparatus. The fire fighter is instructed on the maintenance, maneuvering, and operation of equipment such as pumps, aerial ladders, and elevating platforms. Designed to be used with the Robert J. Brady Transparencies and the International Fire Service Training Association's manual, "Fire Apparatus Practices" (see note), this outline refers to the appropriate page or transparency numbers as guides. (An outline of the whole course covering all fourteen topics briefly is in the first volume of the set--CE 016 662.) (ELG)

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FIRE APPARATUS PRACTICES

PURPOSE AND SCOPE

The change of fire apparatus from the early hand-operated machines to our present day fire apparatus has combined necessary usefulness with available automotive power to produce a mobile machine that meets the requirements of fire service. Hand-operated fire apparatus often required eight to ten men to operate the fire pump; and little training and knowledge were needed since its operation involved manual labor. Today's fire apparatus requires only one pump operator, specially trained in mechanical principles, water flow, safety, and operating practices. It is the purpose of this outline to serve as a guide for the proper car, maneuvering and operating of motorized fire apparatus.

This outline was developed to be used in conjunction with the International Fire Service Training Manual Fire Apparatus Practices and the Robert J. Brady Transparencies.

AIM

To develop a better understanding of the practices and principles involving fire apparatus.

COURSE OUTLINE	GUIDES
I. Introduction.	
A. Definition of fire apparatus - mobile machines used to perform specific fire fighting and rescue functions and to transport fire fighters and equipment.	
B. NFPA Standard Number 19 - "Automotive Fire Apparatus".	
1. Standard apparatus.	
2. Nonstandard apparatus.	
C. Underwriters Laboratory, Incorporated testing and certification for fire apparatus.	
II. Automotive Fire Apparatus (classified according to function).	Fire Apparatus Practices, Section I
A. Pumpers.	
1. 500 GPM.	
2. 750 GPM.	
3. 1000 GPM.	
4. 1500 GPM.	
B. Aerial ladders.	
C. Elevating platforms.	
D. Squads.	
E. Tankers.	
F. Brush apparatus.	
G. Rescue apparatus.	

COURSE OUTLINE	GUIDES
H. Ambulance.	
I. Aircraft fire apparatus.	
J. Chemical fire apparatus.	
K. Power or floodlight apparatus.	
L. Quads or quints.	
M. Pumper - elevating water device combination.	
N. Pumper fireboats.	
III. Maneuvering Fire Apparatus.	
A. Drivers' responsibilities.	
1. Ability to safely control and maneuver fire apparatus.	
2. Knowledge of laws and regulations pertaining to him.	
3. Keeping apparatus in good operating condition.	
4. Keeping accurate inventory of equipment carried on apparatus.	Volunteer Practices Section 12
5. Safety of men riding apparatus.	Uniform Records & Reporting System, N. C. League of Muncipalities P. 98-104.
6. Knowing location of streets, hydrants, water sources, and major buildings.	
7. Proper placement of apparatus at fires.	
8. Proper operation of apparatus at fires.	
9. Keeping records of apparatus.	Fire App. Practices Section 4

COURSE OUTLINE	GUIDES
B. Safe driving practices.	
C. Safe winter driving practices.	
1. Get feel of the roads.	
2. Go slowly.	
3. Keep windshield clear.	
4. Use chains on ice and snow.	
5. Pump brakes to slow down or stop.	
6. Follow other vehicles at safe distance.	
D. Driving exercises.	
1. Braking exercise - measure total stopping distance of apparatus.	Fire App. Practices P. 33
(a) Stopping distance.	
(1) Driver reaction time.	
(2) Vehicle braking time.	
2. Serpentine exercise - measure driver's ability to steer apparatus in close limits without stopping.	Fire App. Practices
(a) Backward.	
(b) Forward.	
3. Alley dock exercise - measures driver's ability to drive past dock and then back apparatus into space.	Fire App. Practices P. 35

COURSE OUTLINE	GUIDES
4. Opposite alley exercise - measures driver's ability to steer apparatus within close limits.	Fire App. Practices P. 36
5. Diminishing clearance exercise - measures driver's ability to steer apparatus in straight line, to judge distances, and to stop at a given line.	Fire App. Practices P. 36
6. Straight line exercise - measures driver's ability to travel continuously in one direction without weaving.	Fire App. Practices P. 37
7. Turning around exercise - measures driver's ability to turn apparatus around.	Fire App. Practices P. 37
8. Driver's road test.	Fire App. Practices P. 38
(a) Conducted for all drivers.	
(b) Results of test kept in personnel file.	
E. Spotting fire apparatus.	
1. Definition - the act of manuevering the vehicle into position for the most effective performance.	
2. Spotting pumpers.	
(a) Factors which determine where and how to spot pumpers.	
(1) Volume of water needed.	
(2) Immediate need for effective fire stream.	

COURSE OUTLINE	GUIDES
(3) Availability of water.	
(4) Hose and pumper capacity and type.	
(b) Spotting when using non-collapsible hose at draft.	
(1) Front intake.	Fire App. Practices P. 41
(2) Rear intake.	
(3) Side intake.	
(c) Spotting when using noncollapsible intake hose at hydrant.	Fire App. Practices P. 42
(1) Intake connected to pumper first.	
(2) Intake connected to hydrant first.	
(d) Spotting when using soft flexible intake hose at hydrant.	Fire App. Practices P. 43
(1) Side intake.	
(2) Front intake.	
(3) Rear intake.	
3. Spotting aerial ladders.	
(a) Factors which determine where and how to spot aerial ladders.	
(1) Location of other apparatus.	

COURSE OUTLINE	GUIDES
(2) Location of and distance needed to remove equipment from aerial ladder.	
(3) Location of and distance needed for other operation near aerial ladder.	
(4) Stability of aerial ladder and climbing angle desired.	Fire App. Practices P. 45, Fig. 2
a. Length of ladder.	
b. Height of building.	
c. Operation desired.	
(5) Obstructions to ladder.	
a. Overhead.	
b. Ground level.	
(6) Grade or slope of area.	
(7) Structural condition of building and possibility of collapse.	
(8) Rescue operations needed.	
(9) Possibility of explosions.	
(b) Spotting for firefighting.	
(c) Spotting for rescue.	
4. Spotting elevating platforms.	

COURSE OUTLINE	GUIDES
(a) Factors which determine where and how to spot elevating platforms.	
(b) Spotting for firefighting.	
(c) Spotting for rescue.	
IV. Apparatus Mechanical Operation and Functional Equipment.	
A. Pumper functional equipment.	
1. Fire pumps.	
(a) Centrifugal fire pumps.	Brady Transparencies Unit 8, Sec. 1 No. 2
(1) Definition - Centrifugal - To proceed away from the center, to develop outward, or to impel an object outward from a center of rotation.	
(2) Main parts.	Fire App. Practices P. 53, 55 Figs. 3, 4, 5, 6 Brady Transparencies Unit 8, Sec. 1, No. 1 Fire App. Practices P. 55, Fig. 6
a. Impeller - provides centrifugal force to create velocity.	
b. Casing or housing - conducts water outward through discharge.	
(3) Types.	
a. Single stage pump.	
1. One casing.	
2. One impeller.	

COURSE OUTLINE	GUIDES
b. Multi-stage pump.	
1. Two, three or four impellers normally mounted on one drive shaft.	
2. Each impeller encased in own casing.	
3. Combination of each impeller casing is referred to as a stage.	Fire App. Practices P. 55, Figs. 5 & 6
(4) Centrifugal fire pumps and volume and pressure.	
a. Volume - capacity - parallel.	Fire App. Practices P. 57, Fig. 7 P. 61, Fig. 10
1. Parallel operation.	
2. All passageways from the various stages of the pump are arranged to work with each other side by side.	Brady Transparencies Unit 8, Sec. 1 No. 4
3. Volume is equal to the sum of the capacities of all stages.	
b. Pressure-series.	Fire App. Practices P. 58, Fig. 8 P. 61, Fig. 11
1. Series operation.	
2. Discharge passageway from one impeller is connected to the intake of the next impeller.	Brady Transparencies Unit 8, Sec. 11 No. 4

COURSE OUTLINE	GUIDES
3. Each impeller pumps the same volume of water to the discharge, but the pressure developed by both stages is combined.	
c. Pumps are switched from series to parallel and back by use of a transfer or change-over valve.	
1. Change direction of water from within the pump from one impeller to another.	
(a) From first impeller to discharge - volume.	
(b) From first impeller to intake of second impeller - pressure.	
2. May be mechanically, electrically or hydraulically operated.	
(b) Positive displacement fire pumps.	
(1) Based upon following hydraulic principle: When a pressure is applied to a confined liquid, the same pressure is transmitted within the liquid, outward and equally in all directions.	
(2) Types.	
a. Rotary gear (positive) pump.	Fire App. Practices P. 63, Fig. 12

COURSE OUTLINE	GUIDES
1. Rotors disengage and pick up water at intake side of pump and trap it between the rotors and the pump casing. As the rotors move, the water is moved toward the discharge side of the pump where the rotors re-engage and force the water out.	Brady Transparencies Unit 8, Sec. 1 No. 1
2. Essentially self priming pumps.	
3. Relief valve required.	Fire App. Practices P. 63, Fig. 12
4. Normally used as auxiliary pumps.	
b. Rotary vane pumps.	Fire App. Practices P. 64, Fig. 13
1. The one rotary mounted off center in the casing is equipped with vanes in grooves. As the rotor turns, the vane recedes into the rotor. As the rotor continues to turn, the vane moves out from the rotor and against the casing. As the rotor moves, the space between the rotor and casing is filled with water from the intake and the vanes push or force the water out the discharge.	Brady Transparencies Unit 8, Sec. 1 No. 1

COURSE OUTLINE	GUIDES
2. Normally used for small volume pumping and for priming pumps.	
c. Piston pump.	Fire App. Practices P. 65, Fig. 14
1. As the piston moves forward a vacuum is created which draws water into the chamber. As the piston moves back against the water, a positive pressure is created. Valves permit water to enter through an intake port and escape through a discharge orifice.	Brady Transparencies Unit 8, Sec. 1 No. 1
2. Normally used today as high pressure pumps.	
C. Fire apparatus pumps.	
1. Selecting a particular type of pump for a special function.	
2. Today fire pumps are required for volumes of from 10 to 1500 GPM and for pressures of from 50 to 3000 P.S.I.	
3. Types.	
(a) Pressure-volume pumps.	
(1) High pressure at reduced volume.	
(2) Large volume at reduced pressure.	
(3) Centrifugal pumps.	

COURSE OUTLINE	GUIDES
(4) Most commonly used. (b) Booster pumps. (1) Normally designed to deliver small volumes at a moderate pressure. (2) Normally mounted on chassis frame and powered from a power take off. (3) May be centrifugal, rotary gear, rotary vane, or piston pumps. (c) High pressure pumps. (1) Small volume (10-100 GPM) and extra high pressure (600-1000 P.S.I.). (2) Normally used with specially designed high-pressure nozzles. (3) Normally mounted on chassis frame and powered from a power take off (up to 100 GPM). (4) May be multi-stage centrifugal, rotary gear, rotary vane, or piston pumps. 2. Pump drives. (a) Midship. (b) Front mount. (c) Power take-off.	Fire Apparatus Practices, p. 69, Fig. 15

COURSE OUTLINE	GUIDES
(d) Auxiliary engine. (1) Skid mounted. (2) Trailer mounted. (3) Built into apparatus. 3. Pump shifting devices. (a) Changes motor from drive gear to pump gear. (b) Actual method of shifting will depend upon make and model of apparatus.	
4. Pump connections. (a) To feed water into and deliver water from the pump. (b) Minimum size pump inlets. (1) 500 GPM pumper - $4\frac{1}{2}$ inch. (2) 750 GPM pumper - 5 inch. (3) 1000 GPM pumper - 6 inch. (4) 1250 GPM pumper - 6 inch. (5) 1500 GPM pumper - 6 inch. (c) Minimum of one $2\frac{1}{2}$ inch supply inlet with valve for special hook-ups.	Fire App. Practices P. 72, Fig. 16 P. 73 Brady Transparencies Unit 8, Sec. 1 Nos. 2, 5, & 9

COURSE OUTLINE	GUIDES
(d) Minimum of one 2½ inch discharge outlet for each 250 CPM rated capacity. All controlled with full-flow valves.	
(e) Minimum 5 inch diameter fill opening with screen for tanks also equipped with venting and overflow pipes.	
(f) Proper size booster tank inlet to pump.	
5. Pump controls.	
(a) Electrically, manually, or hydraulically operated.	
(b) Types.	
(1) Change-over valve.	See IV, A, 1, a, 4, c
(2) Relief valve.	Fire Apparatus Prac. p. 27, Fig. 18 p. 80, Fig. 19 p. 81, Fig. 20
a. Found on all positive displacement pumps and some centrifugal pumps.	
b. Main purpose is to control pump pressure, thus preventing pressure build-up.	Brady Transparencies Unit 8, Sec. 1, No. 11
c. Usually consists of an adjustable spring-loaded pilot valve that will operate to bypass water from the discharge to the intake chamber of the pump.	

COURSE OUTLINE	GUIDES
(3) Pressure regulator or governor.	Fire App. Practices P. 82, Fig. 21 P. 83, Fig. 22 P. 84, Fig. 23
a. Impeller speed determines pressure and engine speed determines impeller speed, therefore, you can reduce the pressure by reducing the engine speed.	
b. Governor is actuated by pressure to adjust the engine throttle.	Brady Transparencies Unit 8, Sec. 1 No. 12
c. Regulates power output of the engine to match set pump discharge requirements.	
6. Priming devices.	
(a) Rotary gear or rotary vane primer exhausts air by positive displacement.	Fire App. Practices P. 86, Fig. 24 Brady Transparencies Unit 8, Sec. 1, No. 10
(b) Vacuum primer (manifold) - utilizes vacuum created within engine intake manifold.	Fire App. Practices P. 86, Fig. 25
(c) Exhaust ejector primer - utilizes engine exhaust pressure through venturi system.	Fire App. Practices P. 88, Fig. 26
7. Pump valves.	
(a) Pump connection valves.	
(b) Bleeder valves.	

COURSE OUTLINE	GUIDES
(c) Pump drain valves.	
8. Tachometer.	
(a) Registers speed in revolutions per minute.	
(b) Enables pump operator to operate pump and engine within limits of its design.	
9. Gauges.	Fire App. Practices P. 91, Fig. 27 Brady Transparencies Unit 8, Sec. 1 Nos. 6, 7, & 13
(a) Utilizes spring tube which expands and contracts with change in water pressure, causing needle to move up or down on face.	
(b) Two types.	
(1) Pressure - reads pressure only.	
(2) Compound - reads pressure and vacuum.	
(c) Purpose.	
(1) Discharge pressure.	
(2) Intake pressure.	
(3) Inches of vacuum (drafting).	
10. Cooling systems.	
(a) Fire apparatus cooling system.	
(1) Radiator.	

COURSE OUTLINE	GUIDES
(2) Water pump.	
(3) Fan.	
(b) Auxiliary cooling systems.	
(1) Heat exchanger.	Fire Apparatus Practices, p. 93, Fig. 28
(2) Oil cooler.	
(3) Radiator filler.	
11. Pump bypass proportioners.	Fire Apparatus Prac. p. 94, Fig. 29
(a) Devices that bypass water from the pump through the proportioner to the discharge line.	
(b) Valve allows either plain water or foam or wetting agent to mix with water.	
(c) Operated independently from the pump.	
B. Pumper operations.	
1. Putting pump in gear.	
(a) Sequence of operation for putting a pump in gear will vary with the design of apparatus, type of pump and priming device, and the function to be fulfilled.	
(b) Steps required depend largely upon the pump location.	
(c) Refer to manufacturer's operation manual.	

COURSE OUTLINE	GUIDES
2. Getting water into the pump.	
(a) Booster tank.	
(b) Hydrant.	Fire App. Practices P. 77, Fig. 17
(c) Drafting.	Brady Transparencies Unit 8, Sec. 1, No. 14
3. Pumping.	Brady Transparencies Unit 8, Sec. 2, Nos. 1-9
(a) Hydrant pressure.	
(b) Valve operation.	
(c) Volume - pressure operation.	
(d) Engine operation during pumping.	Guide Sheets 1 & 2.
4. Shutting down pumps.	
(a) Retard throttle slowly to idling engine speed.	
(b) Close discharge valves.	
(c) Check booster tank and refill if needed.	
(d) Close cooling system and disengage governor or pressure regulator.	
(e) Disengage pump	
(f) Close hydrant or remove hose from water.	

COURSE OUTLINE	GUIDES
(g) Bleed hose lines and drain pump if necessary.	
(h) Disconnect supply hose and replace intake caps. Disconnect discharge hose and replace discharge caps and close bleeder valves.	
(i) Prime and/or fill pump with water from booster tank.	
(j) Replace appliances.	
5. Trouble shooting during pumper operation.	Fire App. Practices P. 99, 100, 101, 102
C. Aerial ladder functional equipment.	Fire App. Practices P. 105
1. Ladder.	
(a) Truss principle.	Fire App. Practices P. 106, Fig. 31
(b) Material of construction.	
(1) Steel.	
(2) Heat treated aluminum alloy.	
(3) Wood (no longer manufactured).	
2. Hoisting cylinders and extension cables.	Fire App. Practices P. 107, Fig. 32
3. Turntable.	Fire App. Practices P. 108, Fig. 33
4. Control pedestal.	Fire App. Practices P. 109, Fig. 34
(a) Hoisting control lever.	
(b) Extension control lever.	

COURSE OUTLINE	GUIDES
(c) Rotation control lever.	
(d) Engine starter switch.	
(e) Light switch.	
(f) Hydraulic oil pressure gauge.	
(g) Cylinder pressure gauge.	
(h) Bypass valve.	
(i) Extension indicator.	
(j) Lock and stop controls.	
(k) Inclinometer.	
(l) Lock valve wheel.	
5. Ladder locks and stops.	Fire App. Practices P. 111, Fig. 35
6. Stabilizing jacks.	
D. Aerial ladder operations.	
1. Preparing for use.	
(a) Set braking devices and engage hydraulic pump.	
(b) Place wheel chocks.	
(c) Stabilize apparatus.	

COURSE OUTLINE	GUIDES
2. Placing aerial ladder in position.	
(a) Elevate.	Fire Apparatus Prac. p. 115, Fig. 36A
(b) Rotate.	p. 115, Fig. 36B
(c) Extend fly sections.	p. 117, Fig. 36C
(d) Lower to position.	p. 117, Fig. 36C
3. Aerial ladder safety factors.	
(a) All ladders are stronger when load is applied perpendicular to rungs than when load is applied sideways.	
(b) The lower the hoisted angle of the ladder, the less load it will safely carry.	
(c) When unsupported at the end and with a hoisted angle less than 50 degrees, the ladder will carry $\frac{1}{4}$ of the load it would carry if placed against a building.	
(d) When properly supported at the outer end, a concentrated load at the center of the ladder places much more stress than the same load distributed over the length.	
(e) When unsupported, a concentrated load at the outer end places twice the stress than the same load distributed over the length would.	
(f) As the ladder is extended, the safe load it will carry is reduced.	

COURSE OUTLINE	GUIDES
(g) A shock load may impose stresses many times greater than if the load were normally applied.	
(h) When a ladder must be extended beyond the recommended limits, it should be extended over the front or the rear of the apparatus.	
(i) Always ease the ladder gently into buildings and always lift it off buildings.	
(j) Ground ladders may be used as braces when the aerial ladder must be used beyond recommended limits at low angles.	
(k) Always engage ladder locks and close hydraulic lock valves before using the ladder.	
(l) Where tall ladders are used in high winds, guy ropes are recommended.	
4. Operating ladder pipes.	Fire App. Practices P. 121-122 Fig. 37 & 38
(a) Bed ladder pipes.	
(b) Top fly ladder pipes.	
(c) Aerial ladder pipe safety factors.	
(1) Firefighters operating ladder pipes should always use safety belts.	

COURSE OUTLINE	GUIDES
(2) Only one man should be allowed on the top section during ladder pipe operations. (3) Avoid any sudden movements or surges in using the ladder pipe. (4) Do not direct flow toward electrical wiring at close range. (5) Locate feeder hose in center of ladder, not over the side. (6) All turntable movements during ladder pipe operations should be slow and smooth. (7) Rule of thumb - 75-80-85. a. 75 degrees elevation. b. 80% extended length. c. 85 pounds nozzle pressure - $1\frac{1}{2}$ inch tip. (8) Ladder pipe must be used perpendicular to rungs with a maximum lateral movement of 15 degrees to either side. (9) Never use a $2\frac{1}{2}$ inch hand line and nozzle strapped to the ladder as a ladder pipe. E. Elevating platform functional equipment. 1. Platform. 2. Elevating boom.	

COURSE OUTLINE	GUIDES
(a) Solid steel box-beam.	
(b) Tubular truss-beam.	
(c) Contains water pipe, hose, and air, hydraulic, and electric lines.	
3. Hydraulic lift cylinders.	
4. Control stations.	
(a) Dual control system.	
(1) Street level.	
(2) Platform.	
(b) Safety controls and devices.	
(c) "Intercom" system.	
5. Outriggers.	
6. Turntable.	
F. Elevated platform operation.	
1. Preparing for use.	
(a) Set braking device and engage hydraulic pump.	
(b) Lower outriggers.	
(c) Locate platform for mounting.	
2. Placing elevating platform into position.	Fire App. Practices P. 131, Fig. 40

COURSE OUTLINE	GUIDES
(a) Raising platform. (b) Extending platform. (c) Lowering platform. 3. Elevating platform safety factors. (a) Do not attempt to operate platform on slopes in excess of 20 degrees. (b) Maximum load capacity of platform will decrease in direct proportion to the nozzle reaction force in pounds during master stream operations. (c) Brakes and outriggers must always be set during operations. (d) Always exercise extreme caution when operating near electrical power lines. (e) Avoid any sudden movement or surges during master stream operations. (f) Operator should never leave platform and move onto any buildings or objects. (g) When people are with the platform operator, an operator should be at the ground controls. (h) Be sure boom is in transport position and outriggers are fully retracted before traveling. (i) If equipped with "deadman" switch, be certain the device is not held in contact when platform is not moving.	

COURSE OUTLINE	GUIDES

(j) Always rotate turntable until operator faces the working area, then move forward.

V. Maintenance.

A. Equipment maintenance - items carried on but not permanently attached to the apparatus.

1. Daily maintenance.

(a) Check portable extinguishers.

(b) Check all hose loads.

(c) Check all ladders.

(d) Check all nozzles and appliances.

2. Weekly maintenance.

(a) Check air or oxygen pressure in protective breathing equipment.

(b) Remove and clean all appliances.

(c) Check all flashlights.

(d) Start and warm up all portable motor driven equipment.

3. Periodic maintenance.

(a) Remove, check, and reload all hose.

(b) Service test all hose.

(c) Remove and clean all ladders.

COURSE OUTLINE	GUIDES

(d) Flush pump and booster tank.

(e) Lubricate all motor, gear and hand operated appliances.

B. General apparatus maintenance schedules.

1. Daily maintenance.

(a) Check crankcase oil level.

(b) Check water level in radiator.

(c) Check batteries.

(d) Check all warning signals.

(e) Check fuel levels.

(f) Check booster tank water level.

(g) Check tires.

(h) Check brakes by operating foot pedal.

(i) Clean apparatus body.

2. Weekly maintenance.

(a) Check transmission oil level.

(b) Check differential oil level.

(c) Check master brake cylinder fluid level.

(d) Check fan belt and generator belts.

COURSE OUTLINE	GUIDES
(e) Check battery terminals and cables. (f) Operate valves in cooling system. (g) Check drains and hose connections. (h) Check drive shaft and universal joints. (i) Start and warm up engine and observe oil pressure and idling speed. (j) Clean motors and underneath chassis. (k) Check for loose nuts, studs, and pins. (l) Check fire pump. (m) Check aerial ladder. (n) Check elevating platform. 3. Periodic maintenance. (a) Clean air filter and change oil. (b) Drain and refill crankcase (3 months). (c) Clean sludge from crankcase (6 months). (d) Clean sediment bowls and check fuel pump. (e) Clean sparkplugs and set gap. (f) Lubricate chassis, distributor, starting motor, water circulating pump, generator and alternator, and steering gear.	

COURSE OUTLINE	GUIDES
(g) Service test apparatus.	
C. Apparatus and maintenance records.	Fire App. Practices Pgs. 139, 140, 141, 142, 143, 144
1. Inventory records.	
(a) Apparatus.	
(b) Equipment.	
2. Preventive maintenance records.	
3. Shop check-up.	
4. Minor repairs.	
5. Major repairs.	
6. Parts replacement.	
7. Oil and lubrication records.	
8. Driver's mechanical reports.	
9. Mileage and hours records.	
D. In service maintenance program.	
1. Cleanliness.	
(a) Public relations benefit.	
(b) Ease of inspection.	
(c) Trouble-free operation.	

COURSE OUTLINE	GUIDES
2. Lubrication. 3. Electrical components. (a) Lighting system. (b) Electrical motors. (c) Battery. (d) Voltage regulator. (e) Generator or alternator. 4. Engine. (a) Gasoline. (b) Diesel. 5. Chassis components. (a) Check drive line units. (b) Check master cylinder brake fluid reservoir. (c) Check power steering hydraulic fluid reservoir. (d) Check for brake fluid leaks. (e) Check brake pedal for clearance. (f) Check brake pedal while driving.	

COURSE OUTLINE	GUIDES
(g) Check tire pressure and condition. (h) Check universal joints. (i) Check steering devices. (j) Check tail pipe and muffler. (k) Check parking brake adjustment. 6. General fire pump maintenance. (a) Open all pump drains and flush out sediment. (b) Check and clean intake strainers. (c) Check oil level in pump gear box. (d) Operate pump primer with all pump valves closed. (e) Operate change-over valve while pumping from booster tank. (f) Check packing glands for leaks. (g) Operate all valves with pump pressure of 100 P.S.I. 7. Fuel and water supply tanks. 8. Aerial ladder maintenance. (a) Control pedestal operations and observation.	

COURSE OUTLINE	GUIDES
(b) Check hydraulic fluid line connections. (c) Check extension cables and drums. (d) Check turntable. (e) Check section extensions. (f) Check hydraulic stabilizing jacks. (g) Clean and lubricate all races and sliding surfaces. 9. Elevating platform maintenance. (a) Control stations operation and observations. (b) Check hydraulic fluid line connections. (c) Check brakes and locks. (d) Check overriding controls and deadman switch. (e) Check outriggers and stabilizing jacks. (f) Check turntable operation. (g) Check rotation and leveling devices. VI. Testing Fire Apparatus. A. Road performance tests.	

COURSE OUTLINE	GUIDES
1. The loaded apparatus shall, from a standing start through all gears, attain a speed of 35 m.p.h. within 30 seconds.	
2. The loaded apparatus shall, from a steady speed of 13 m.p.h., accelerate to 35 m.p.h. in 30 seconds in direct drive.	
3. The loaded apparatus shall attain a top speed of not less than 50 m.p.h. in a reasonable distance.	
4. Service and parking brake shall operate independently and be capable of holding the fully loaded vehicle on a 20 percent grade or maximum grade specified.	
5. Service brakes shall be capable of stopping the fully loaded apparatus while traveling 20 m.p.h. in a distance not exceeding 30 feet on a dry, hard-surfaced road.	
B. Pumping performance tests.	
1. Engine shall be large enough to permit the apparatus to comply with the pumping requirements specified in NFPA Standard No. 19 without exceeding the maximum no-load governed speed of the engine.	NFPA Standard #19 Automotive Fire Apparatus
2. Lift - with pump dry, it is required to take suction and discharge water from a vertical lift of 10 feet in not more than 30 seconds through 20 feet of suction hose of appropriate size. Pumps of 1500 GPM capacity are required to take suction in not over 45 seconds.	

COURSE OUTLINE	GUIDES
3. Acceptance and certification test.	
Note: Net pump pressure is the sum of the pump discharge gauge pressure, plus the vertical distance from water level to the gauge (lift) plus friction loss factors.	Fire App. Practices P. 157 for formula and tables
(a) Two hours at 100 percent rated capacity at 150 P.S.I. net pump pressure.	
(b) One-half hour at 70 percent rated capacity at 200 P.S.I. net pump pressure.	
(c) One-half hour at 50 percent rated capacity at 250 P.S.I. net pump pressure.	
(d) A short overload or spurt test at 100 percent rated capacity at 165 P.S.I. net pump pressure.	
4. Annual service test.	Fire App. Practices P. 159, Fig. 41 P. 161, Fig. 42
(a) Equipment needed.	
(1) Necessary hose and nozzles.	
(2) Pitot tube and gauge.	
(3) Pressure gauge.	
(4) Revolution counter.	
(5) Stop watch.	
(b) Service test requirements.	

COURSE OUTLINE	GUIDES

(1) Twenty minutes at 100 percent rated capacity at 150 P.S.I. net pump pressure.

(2) Ten minutes at 70 percent rated capacity at 200 P.S.I. net pump pressure.

(3) Ten minutes at 50 percent rated capacity at 250 P.S.I. net pump pressure.

5. Dry vacuum test - for testing pump for tightness and ability of priming device to function properly.

Note: Should be conducted twice annually or after major repairs.

(a) Close booster tank valve and completely drain pump.

(b) Attach 20 feet of hard suction hose to pump intake and cap end. (All connections must be tight).

(c) Close all discharge valves, auxiliary drains and remove discharge caps.

(d) Operate priming device and develop 22 inch vacuum.

(e) Disengage priming device and permit to stand for ten minutes with no further operation.

COURSE OUTLINE	GUIDES
(f) If vacuum does not drop more than ten inches during ten minute period, the apparatus has passed the test.	
C. Testing metal aerial ladders for strength.	NFPA Standard No. 193
Note: The test should be conducted annually or when the ladder may have been subject to stresses beyond recommended limits.	
1. Test materials.	
(a) 6 foot rule.	
(b) Test cable hanger.	Fire App. Practices P. 163, Fig. 43
(c) 3/8 inch diameter steel cable 50 feet long with cable clamps and forged hook.	
(d) A container of 60 gallon capacity (for water) or a platform with proper attachment for test cable.	
(e) 50 pound sandbag.	
(f) 400 pounds of weight (tank and water or weights and platform).	
(g) Protractor with spirit level if angle scale is not provided on truck.	
(h) Test forms.	Fire App. Practices P. 165

COURSE OUTLINE	GUIDES
2. Test conditions.	
(a) Conduct test in still air.	
(b) Close observation for twist in ladder (if twist is observed, discontinue immediately).	
(c) For ladder over 10 years in service, use 300 instead of 400 pounds.	
(d) 400 pound load is for ladder with rung braces on all sections. (Ladders built since June 1, 1943).	
(e) 335 pound load should be used for ladders without rung braces.	
3. Test procedures.	
(a) Locate apparatus on level surface with jacks down and locked.	
(b) Extend ladder sections fully to the rear while the ladder is supported by the truck arches.	
(c) Attach 50 pound weight to rear of ladder on the second or third rung from the top of the top section.	
(d) Measure distance from underside of rear rung to the ground midway between ladder rails. Mark the point on the ground where the rule touches.	Fire App. Practices P. 167, Fig. 44

COURSE OUTLINE	GUIDES
(e) Remove the 50 pound weight and retract the sections. Then attach special bracket and cable on the top rung of the top section.	
(f) Elevate ladder to 60 degrees, rotate turntable until ladder is located over the front or rear of the truck. Extend until all sections are two rungs short of full extension. Have section locks in "on" position bearing on the rungs. Close all cylinder shut-offs or safety valves tightly. Check to see that ladder does not lean to either side.	
(g) Attach water tank or platform to the cable and allow 42 inches between bottom of tank or platform and the ground.	Fire App. Practices P. 167, Fig. 45
(h) Add test weight gradually and slowly. Do not drop weight or otherwise shock load the ladder. Keep this load on ladder for five minutes.	
(i) Remove weights and platform or tank.	
(j) Extend sections so locks can be released, then retract sections. Open safety valve and rotate ladder until it is centered on truck pointing toward the rear. Lower ladder and rest it on the truck arches. Remove cable and bracket.	
(k) Extend section fully and add 50 pound weight.	

COURSE OUTLINE	GUIDES
(l) Measure distance from underside of rear rung to the ground. (Previously marked point.) (m) If distance measured is within plus or minus two inches of first measurement, the ladder is in proper condition for continued use. D. Aerial ladder operation test. 1. Prepare aerial for operation (IV, C, 1). 2. Complete cycle of ladder functions including elevating ladder from its bed, rotating it 90 degrees, and extending its sections fully within 60 seconds. 3. After completion of above and retraction and lowering, a thorough inspection of all moving parts should be conducted. 4. Satisfactorily operate all ladder controls.	

Pumping From (Water Supply)	Booster Tank Valve	Discharge Gate Valve $2\frac{1}{2}$" Line	Booster Line Valve	Priming Device	Changeover Valve	Power Selection	Governor	Relief Valve
Booster Tank	Open	Closed	Open	Use If Needed	Pressure	Mfg. Recommendation	Set on Established Pressure	Set for Desired Pressure
Hydrant	Closed	Open	Closed or Open	Not Used	Capacity or Pressure	Mfg. Recommendation	Set on Established Pressure	Set for Desired Pressure
Draft	Closed	Usually Closed (Mfg. Rec.)	Closed	Use	Capacity or Pressure	Mfg. Recommendation	Set on Established Pressure	Set for Desired Pressure
Feeder Line	*Closed	**Closed	Open or Closed	Not Used	Capacity or Pressure	Mfg. Recommendation	Set on Established Pressure	Set for Desired Pressure

*May be left open until feeder line is charged.
**Ordinarily closed except when used to feed $1\frac{1}{2}$-inch lines. Where choice of two is given the first denotes preference.

Guide Sheet Number 2
Suggested Operation of Positive Displacement Pumps

Pumping From (Water Supply)	Booster Tank Valve	Discharge Gate Valve $2\frac{1}{2}$" Line	Booster Line Valve	Priming Device	Changeover Valve	Pump Gear Selection	Governor	Relief Valve
Booster Tank	Open	Closed	Open	None	None	Pressure	None	Set for Desired Pressure
Hydrant	Closed	Open	Closed or Open	None	None	Capacity or Pressure	None	Set for Desired Pressure
Draft	Closed	Open	Closed or Open	None	None	Capacity or Pressure	None	Set for Desired Pressure
Feeder Line	*Closed	**Closed	Open or Closed	None	None	Pressure or Capacity	None	Set for Desired Pressure

*May be left open until feeder line is charged.

**Ordinarily closed except when used to feed $1\frac{1}{2}$-inch lines. Where a choice of two is given the first denotes preference.